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Three New Species of Polydorids (Polychaeta, Spionidae) from Japan

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Three new species of polydorids, *Polydora uncinata* sp. nov., *Polydora aura* sp. nov., and *Carazziella spongilla* sp. nov., are described from Japanese waters. The two species of *Polydora* bore into mollusc shells and coralline algae. The species of *Carazziella* inhabits freshwater sponges in a brackish lake.

Key Words: *Polydora*, *Carazziella*, new species, Spionidae, Polychaeta, Japan, calcareous substrata, boring activity, burrow morphology, freshwater sponge.

Introduction

Spionid polychaetes of *Polydora* and related genera (*Dipolydora*, *Boccardiella*, *Boccardia*, *Carazziella*, *Tripolydora*, *Amphipolydora*, *Pseudopolydora*) are collectively called polydorid species as they have a modified fifth setiger. They are found in a wide variety of habitats, ranging from soft sediments to hard calcareous materials. They are believed to have established themselves in many types of unique habitats or niches in the environment, which accounts for their successful evolution (Blake 1996). Many of them are species-specific in their habitat preference. Polydorids include both boring and non-boring species. No single species has been found to behave both as a borer and non-borer (Sato-Okoshi and Okoshi 1997). Burrow morphology is one of the key characteristics to identify the species (Sato-Okoshi and Nomura 1990; Sato-Okoshi and Okoshi 1997). Previous descriptions or reports of polydorid species from Japan have been included in Söderström (1920), Okuda (1934), Imajima and Hartman (1964), Mizumoto (1964), Myohara (1979, 1980), Kojima and Imajima (1982), Imajima and Sato (1984), Mori *et al.* (1985), El-Komi and Kajihara (1988), Sato-Okoshi *et al.* (1990), Sato-Okoshi and Nomura (1990), Radashevsky (1993), Sato-Okoshi (1994), and Sato-Okoshi and Okoshi (1996).

Two undescribed boring species, which inhabit self-excavated burrows in calcareous substrata, and one undescribed non-boring species, which inhabits mud tubes in freshwater sponges, were found during a survey specially addressed to study the polydorids' boring activity. The present report presents the description of these three species with special attention to their habitat, ecology, reproduction, and burrow morphology.

The type series of the three new species are deposited in the Natural History Museum and Institute, Chiba (NHMIC).

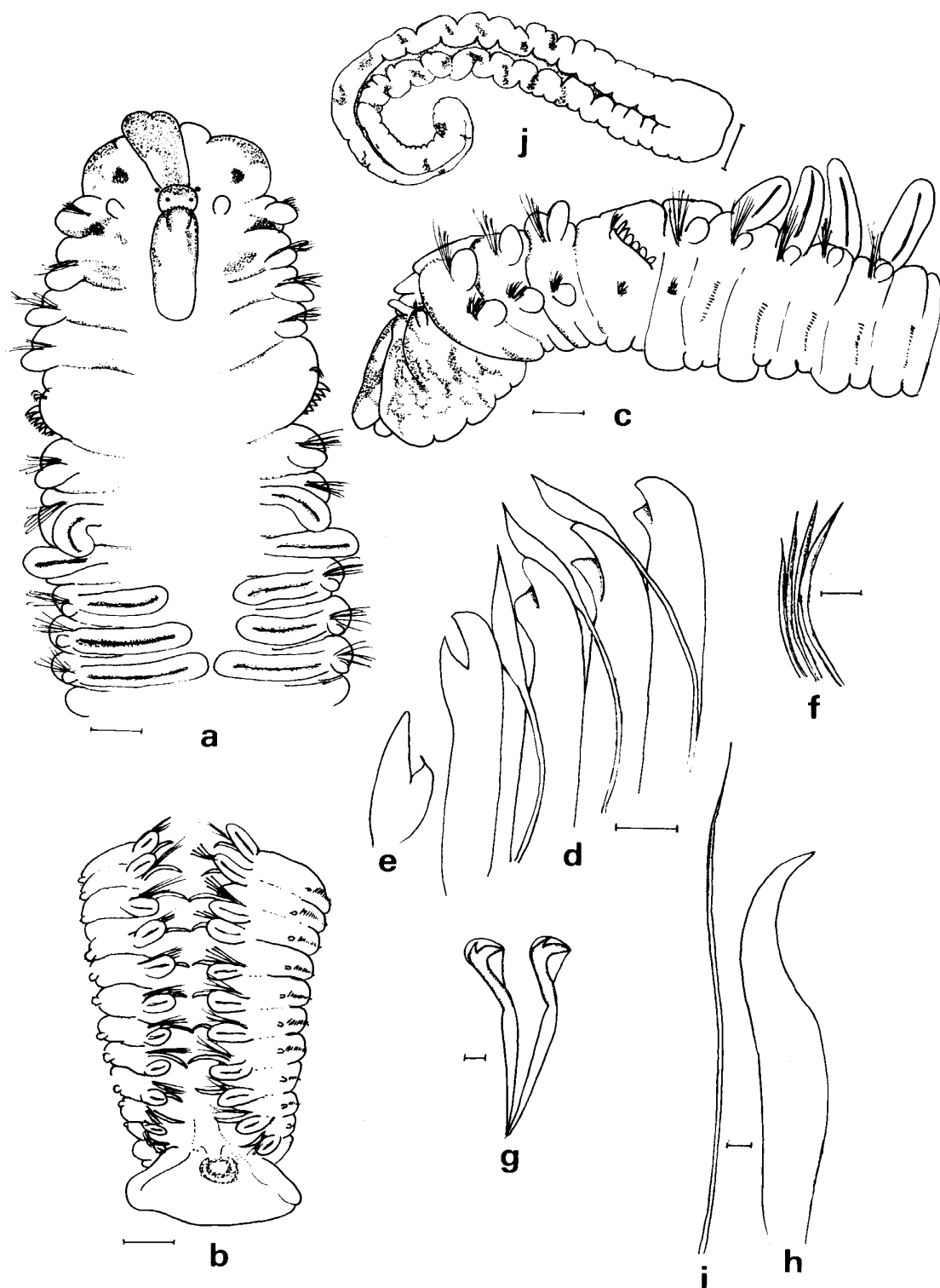


Fig. 1. *Polydora uncinata* sp. nov. a-c, holotype; d-j, paratypes. a, anterior end without palps, dorsal view; b, posterior end, dorsal view; c, anterior end, lateral view; d, modified spines and companion setae of setiger 5; e, modified spine of setiger 5 not yet protruding; f, dorsal winged capillary

Genus *Polydora* Bosc, 1802*Polydora uncinata* sp. nov.

(Fig. 1a-j)

Description: Up to 25 mm long, 1.2 mm wide at setiger 5, for 160 setigers. Color in life light tan.

Prostomium weakly incised anteriorly, caruncle extending to middle or end of setiger 3, short occipital tentacle present; four eyes present, arranged in trapezoid or square. Palps crossed by up to 11 brown spots. Varying degree of dark pigmentation (completely to slightly darkened) on anterior end of prostomium, on and along caruncle, and between setigers 1-4 on both dorsal and ventral sides. Some specimens with two conspicuous black spots on peristomium, one on right and one on left. Some without conspicuous pigmentation on peristomium. Branchiae present from setiger 7, fairly long, continuing to end of body. Setiger 1 without notosetae, only winged capillary neurosetae. Setigers 2-4 with winged capillary neuro- and notosetae.

Modified spines of setiger 5 falcate with lateral tooth, but some worn spines distally rounded and with lateral tooth small or lacking; major spines alternating with pennoned companion setae; short dorsal and ventral unilimbate setae present. Bidentate hooded hooks replacing winged capillary neurosetae from setiger 7, with 12 hooks per fascicle in middle setigers, decreasing to about two hooks per fascicle posteriorly. Hooks with constriction on shaft and main fang at right angle to shaft, with acute angle between main fang and apical tooth. Single recurved hook present on posterior notopodia up to last 13 setigers, these possessing one to five long capillaries as well. Hook slightly bent at tip, broadening at its middle, and then tapering. Branchiae coexisting with hooks and capillaries on posterior setigers.

Pygidium a flaring disc, dorsally wide open.

Habitat and ecology: *Polydora uncinata* excavated burrows in living shells of wild *Omphalius rusticus* (Gmelin) from Shironohana (Kochi Prefecture, Japan) and cultured *Crassostrea gigas* (Thunberg) from Yamada Bay (Iwate Prefecture, Japan). Both *O. rusticus* and *C. gigas* were collected from the intertidal zone. Very little crawling activity was observed after removal from the shell, and the worm is incapable of either forming a new burrow or of hiding itself in mud deposits or in the crevices of calcareous substrata.

Reproduction: Oocytes of 170 μ m in diameter were observed in the specimens extracted in October.

Burrow morphology: *Polydora uncinata* excavates a typical S-shaped burrow as shown in Fig. 4-c. The end of the burrow bends as a hook. The central portion of the burrow is filled with detritus and particles of dissolved shell.

Distribution: Orikasa (Iwate Prefecture) and Shironohana (Kochi Prefecture), Japan.

Remarks: *Polydora uncinata* morphologically resembles *P. hoplura* Claparède, 1870 from Europe (Carazzie 1893; Fauvel 1927), South Africa (Day 1967), New Zealand (Read 1975), and Australia (Blake and Kudenov 1978), and also *P. colonia*

setae of setiger 5; g, bidentate hooded hooks; h, posterior recurved hook; i, posterior long capillary seta accompanied by recurved hook; j, palp. Scale bars 0.2 mm for a-c and j, 0.03mm for d-f and h-i, 0.01mm for g.

Moor, 1907 from eastern North America (Blake 1971), in that the three species possess specialized hooks on the posterior notopodia. However, in comparison with *P. hoplura*, *P. uncinata* is smaller (up to 25 mm long for 160 setigers), an occipital tentacle is present, the caruncle extends to the end of setiger 3, the branchiae continue to the end of the setigers with both hooks and long capillaries, and the hooks bend slightly at their tip, broaden at their middle, and then taper; *P. hoplura* is larger (up to 40 mm long for 180 setigers), an occipital tentacle is absent in European specimens, the caruncle extends to the end of setiger 2 in European specimens, and the branchiae usually end where the curved spines begin at the lower posterior end in New Zealand specimens and always end there in the Australian variety. That is, there is no overlap between the two species. Instead of a recurved "hooked sheet" in *P. uncinata*, the special notoseta of *P. hoplura* is a weakly curved "spine", which is straight in the middle in both New Zealand and Australian specimens, but strongly bent at the tip in South African specimens (Day 1967). Also, the diameter of the oocyte of *P. uncinata* is 170 μm , versus 150 μm in New Zealand specimens of *P. hoplura* with a larger body size. Compared with *P. colonia*, *P. uncinata* is larger, eyes are present, and only one tooth exists on the modified spines, whereas *P. colonia* is smaller, eyes are absent, and two teeth and a collar exist on the modified spines. *Polydora uncinata* is a borer and *P. colonia* inhabits tubes within sponges, forming soft masses attached to pilings and rocks.

Etymology: The specific name derives from the special posterior notopodial hook and the burrow morphology of the species (from Latin *uncinatus* = shaped like a hook, hooked).

Type series: Holotype (NHMIC CBM-ZW-901) and 5 paratypes (NHMIC CBM-ZW-902) extracted from living shells of *Crassostrea gigas* cultured in Orikasa (Yamadacho, Iwate, Japan), collected on 31 October 1997 by K. Okoshi and W. Sato-Okoshi.

***Polydora aura* sp. nov.**
(Fig. 2a-j)

Description: Up to 22 mm long, 1 mm wide at setiger 5, for 175 setigers. Color of body and palp light orange in life. Orange mostly fading or disappearing after fixation, but bright brown or orange pigments remaining on body.

Prostomium anteriorly rounded or weakly incised, caruncle extending to end of setiger 2-4; eyes present or absent, one to four if present, arranged in trapezoid. Branchiae from setiger 7, continuing to end of body. Setiger 1 lacking notosetae, with only winged capillary neurosetae. Setigers 2-4 with both winged capillary neuro- and notosetae.

Modified spines of setiger 5 falcate with lateral flange, but some worn spines simple and falcate without conspicuous flange; major spines alternating with pennoned companion setae; dorsal setae absent, only short winged capillary ventral setae present.

Bidentate hooded hooks replacing winged capillary neurosetae from setiger 7; 15 hooks per fascicle in middle setigers, decreasing to about two hooks posteriorly; hooks with constriction on shaft and with main fang at right angle to shaft. Special notosetae present in setigers of posterior half, consisting of tight cylindrical bundles

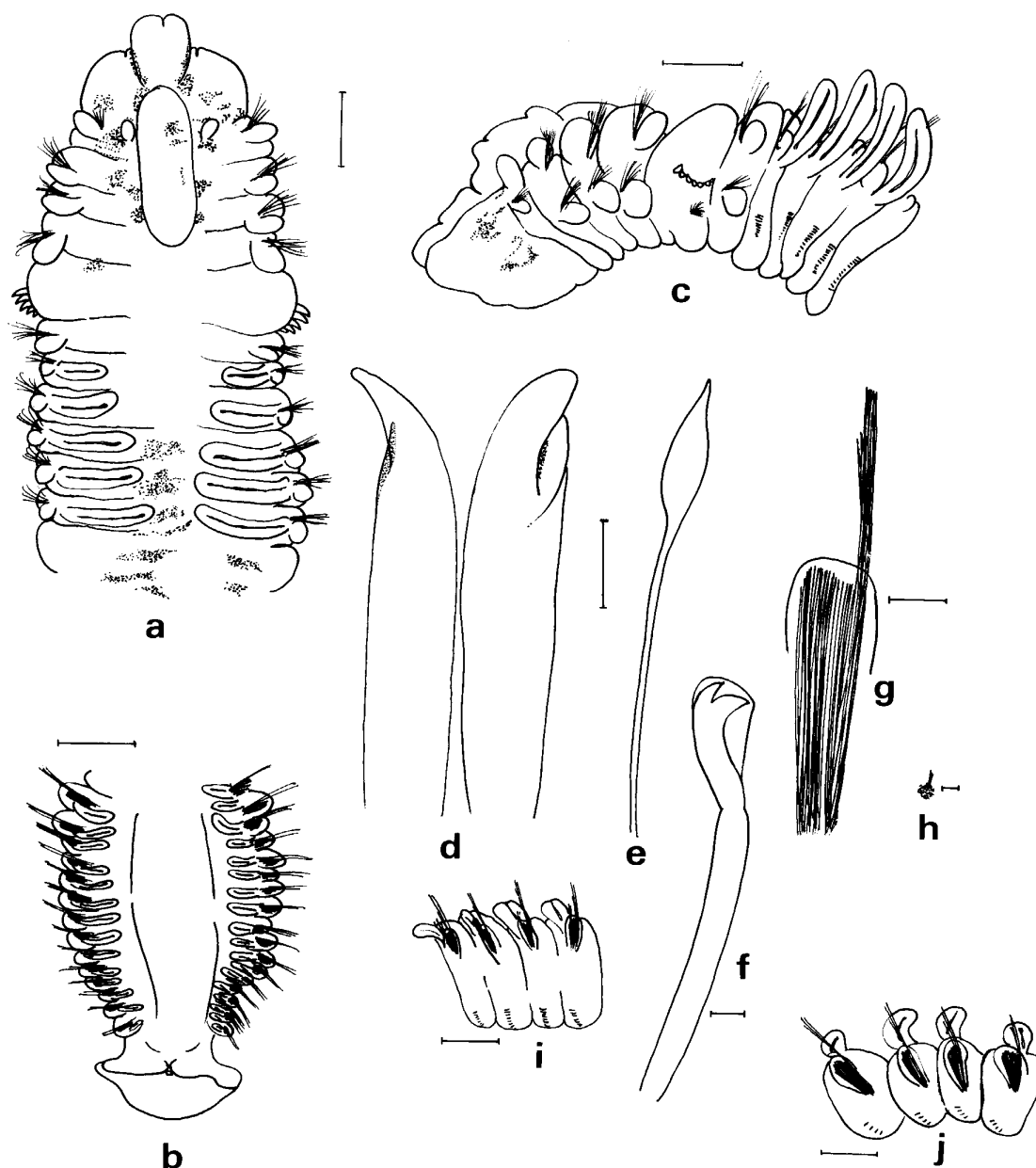


Fig. 2. *Polydora aura* sp. nov. a-c, holotype; d-j, paratypes. a, anterior end without palps, dorsal view; b, posterior end, dorsal view; c, anterior end, lateral view; d, modified spines of setiger 5; e, companion seta of setiger 5; f, bidentate hooded hook; g, posterior notopodium with long capillaries and bundle of short needles; h, bundle of short needles and long capillaries, end view; i, mid-posterior setigers with bundles of spines accompanied by longer capillaries anteriorly and shorter capillaries posteriorly, lateral view; j, post-posterior setigers with bundles of spines accompanied by only long capillaries. Scale bars 0.2 mm for a-c, i, and j, 0.03 mm for d-e, 0.008 mm for f, 0.06 mm for g-h.

of short needles, mostly of equal length, bundles not protruding through cuticle; these accompanied by long and short extended capillaries, longer ones directed anteriorly and shorter ones posteriorly. At very posterior end of body, specialized setae accompanied only by longer extended capillaries.

Pygidium a wide, flaring disc.

Habitat and ecology: *Polydora aura* was extracted from the living shells of various molluscs (*Batillus cornutus* (Lightfoot) from Chikura (Chiba Prefecture, Japan), *Ostrea circumpicta* Pilsbry from Shironohana (Kochi Prefecture, Japan), *Anomia chinensis* Philippi from Uranouchi Bay (Kochi Prefecture, Japan), *Chlamys nobilis* (Reeve) and *Pretostrea imbricata* (Lamarck) from Mishocho (Ehime Prefecture, Japan)) and from living coralline alga growing on *Tectus conus* (Gmelin) from Shironohana in both the intertidal and subtidal zones. Very little crawling activity was observed after removal from the shell, and the worm is incapable of either forming a new burrow or of hiding itself in mud deposits or in the crevices of calcareous substrata.

Reproduction: Two egg strings were found in burrows in September in Uranouchi Bay. In one string, approximately 50 capsules and 35-40 morula of 130 μm in diameter in each capsule were observed. In the other string, simultaneously developing 3-setiger larvae were observed in each capsule. It seems that the hatching stage is the 3-setiger larvae, which had long setae and could swim well when artificially released from the capsule.

Burrow morphology: *Polydora aura* bores U-shaped burrows (Fig. 4-b). The central portion of the burrow is filled with detritus and particles of dissolved shell.

Distribution: Pacific coast of Shikoku plus Boso Peninsula, Japan.

Remarks: *Polydora aura* morphologically resembles *P. latispinosa* Blake and Kudenov, 1978 from Australia (Blake and Kudenov 1978) in that both species possess special packets of needles on the posterior notopodia. However, the bundle of needles of *P. aura* is cylindrical and does not protrude through the cuticle, and longer and shorter capillaries accompany in series of bundle of needles. The special packet of needles of *P. latispinosa* is flattened and sometimes protrudes through the cuticle, and long capillaries do not accompany in series of packet. Furthermore, *P. latispinosa* has an occipital tentacle, whereas *P. aura* does not.

Etymology: The species is named for its color and brightness of body, palp and special posterior notosetae when alive (from Latin *aura* = brilliance, glittering; a noun in apposition).

Type series: Holotype (NHMIC CBM-ZW-903) extracted from the shell of *Batillus cornutus*, Chikura, Chiba, Japan, collected on 23 May 1990 by Chiba Prefectural Fisheries Experiment Station and W. Sato-Okoshi; 2 paratypes (NHMIC CBM-ZW-904) extracted from the shells of *Batillus cornutus*, Chikura, Chiba, Japan, collected on 23 May 1990 by Chiba Prefectural Fisheries Experiment Station and W. Sato-Okoshi; 1 paratype (NHMIC CBM-ZW-905) extracted from the shell of *Pretostrea imbricata*, Mishocho, Ehime, Japan, collected on 12 September 1996 by H. Ishikawa and W. Sato-Okoshi.

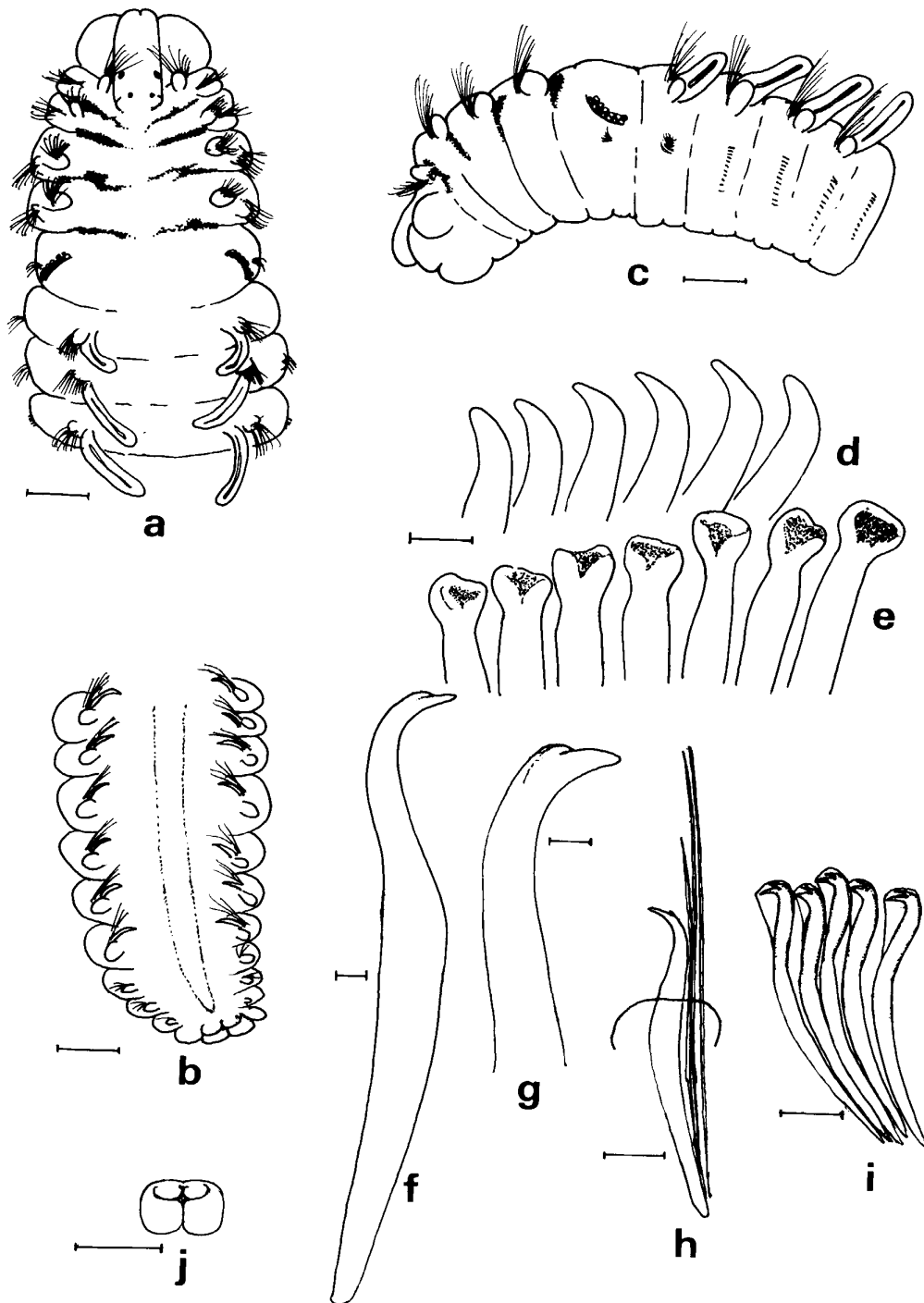


Fig. 3. *Carazziella spongilla* sp. nov. a-c, holotype; d-i, paratypes. a, anterior end without palps, dorsal view; b, posterior end, dorsal view; c, anterior end, lateral view; d, dorsal row of modified spines of setiger 5; e, ventral row of modified spines of setiger 5; f-g, posterior recurved hook; h, posterior setiger with recurved hook and long capillaries; i, bidentate hooded hooks; j, pygidium, posterior view. Scale bars 0.2 mm for a-c and j, 0.03 mm for d-e and i, 0.02 mm for f-g, 0.08 mm for h.

Genus *Carazziella* Blake and Kudenov, 1978

Carazziella spongilla sp. nov.

(Fig. 3a-j)

Morphology: Up to 15 mm long, 0.7 mm wide at setiger 5, for 70 setigers. Color in life light tan, with black pigmentation in each intersetiger of setigers 1-4. Rarely without pigmentation. Palps transparent.

Prostomium flattened, anteriorly weakly bilobed, caruncle extending only to middle or end of setiger 1; four to six eyes present, trapezoidal in arrangement. Branchiae first appearing on setiger 6, continuing only to middle of body, absent from posterior half; branchiae long and narrow. Setiger 1 with well developed, prominent fascicle of notopodial capillaries and shorter capillary neurosetae. Setigers 2-4 with fascicles of winged capillaries in both rami; from setiger 6, long winged capillary notosetae present; neuropodia of setigers 6-7 bearing capillaries only. Bidentate hooded hooks first appearing in neuropodia from setiger 8; hooks with weak constriction on shaft, main fang at right angle to shaft, and only slight angle between teeth; hooks numbering 11 per fascicle in setigers 8-10, gradually diminishing in number to two in posterior setigers.

Setiger 5 modified, bearing two types of modified spines arranged in two rows: (1) ventral row of spines with expanded tips without bristle, (2) dorsal row of simple, falcate spines without bristle; companion setae absent; only fascicle of winged ventral setae of setiger 5 present. About seven ventral spines and six dorsal spines present in one side of setiger 5.

Special large, recurved, hook-like notosetae present on posterior half of notopodia, with small elevation or flange overlapping main fang; one or rarely two hooks per notopodia, accompanied by one to five long capillaries.

Pygidium reduced, with two larger ventral lobes and two smaller dorsal lobes.

Habitat and ecology: *Carazziella spongilla* was only observed to inhabit the freshwater sponge *Spongilla alba* Carter, 1849 in the brackish Lake Shinji, Japan. The salinity of the collecting sites ranged from 0.7 to 2.0‰ (Masuda and Satoh 1990a). Although no *C. spongilla* was observed in the sponge in July, many worms were observed in September at the same collecting sites (Masuda and Satoh 1990b). This suggests that the *settling* period of this species is between July and September. *Carazziella spongilla* forms mud tubes in the sponge (Figs 4-a, 5). Approximately 40 mud tubes were found in 9 cm². *Spongilla alba* is also found in the brackish Lake Hinuma in Ibaraki Prefecture in Japan, but *C. spongilla* was not found associated with it there.

Reproduction: Oocytes of 120 µm in diameter were observed in November.

Tube Morphology: A blindly ending mud tube with its entrance opening on the surface of the sponge (Figs 4-a, 5).

Distribution: Lake Shinji (Shimane Prefecture, Japan).

Remarks: There are 12 described species of the genus *Carazziella* (Rainer 1973; Blake and Kudenov 1978; Blake 1996). It is easy to distinguish *C. spongilla* from other species by its pigmentation, the branchiae first appearing from setiger 6, the morphology of the two types of modified spines of setiger 5 (both types lack a bristle), the special recurved notosetae, and the reduced pygidium.

Etymology: The specific name *spongilla* is derived from the host sponge, *Spongilla alba*; a noun in apposition.

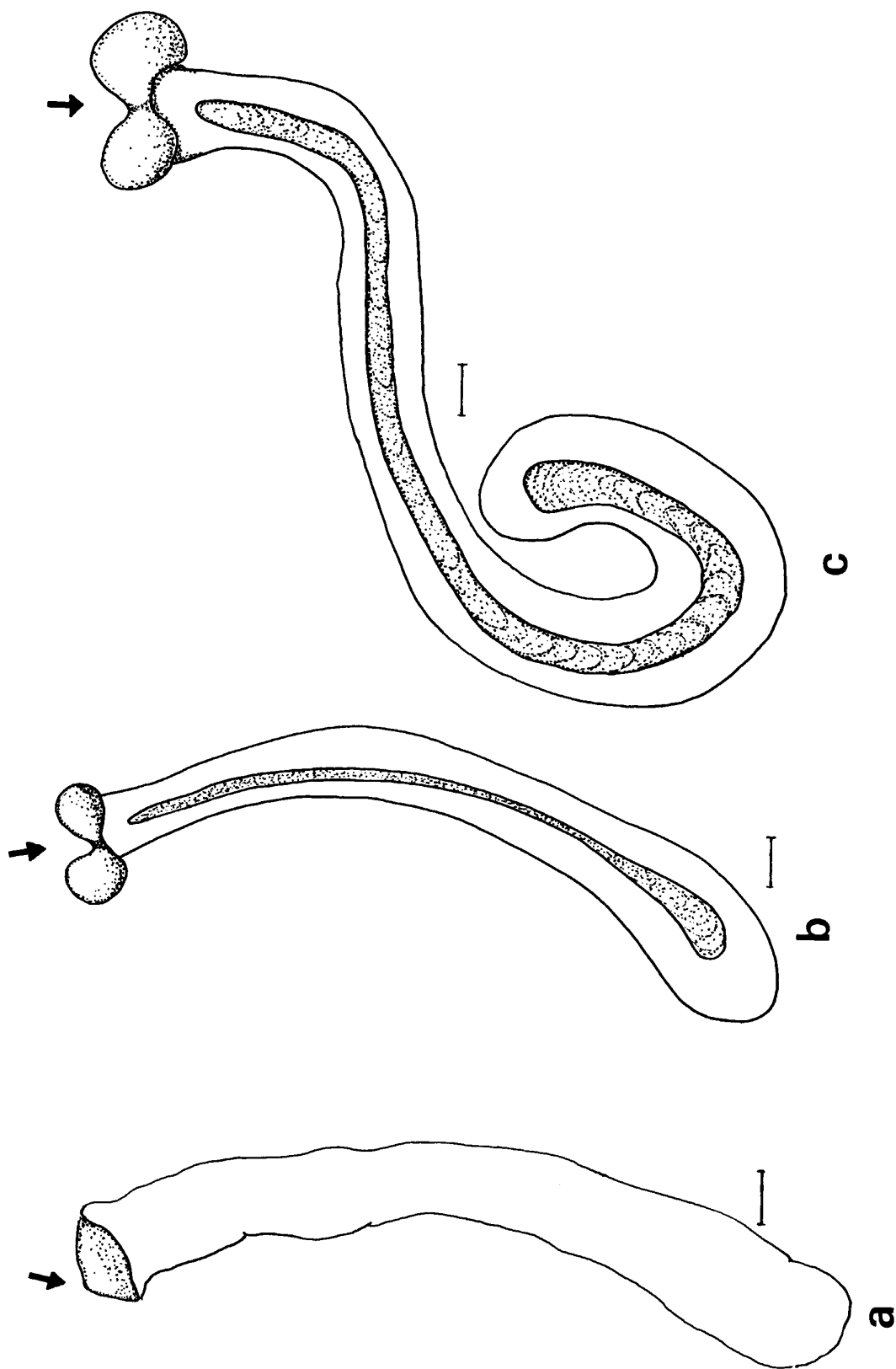


Fig. 4. Burrow and tube morphology. a, mud tube of *Carazziella spongilla* in *Spongilla alba*; b, burrow of *Polydora aura* excavated in shell of *Pratostrea imbricata*; c, burrow of *Polydora uncinata* excavated in shell of *Crassostrea gigas*. Arrows show burrows' entrances. Dotted areas indicate central filled portions of burrows. Scale bars 1 mm.

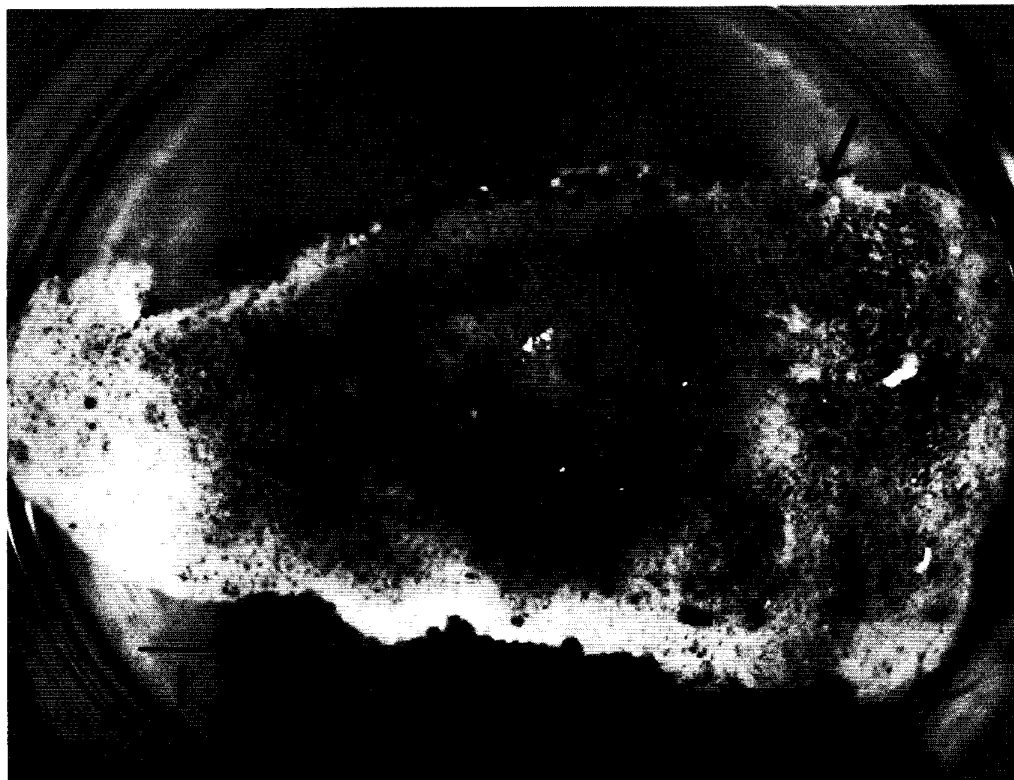


Fig. 5. Freshwater sponge *Spongilla alba* in which *Carazziella spongilla* makes mud tubes. Many entrances of mud tubes can be observed. Arrow indicates one tube entrance.

Type series: Holotype (NHMIC CBM-ZW-906) and 7 paratypes (NHMIC CBM-ZW-907) extracted from the sponge *Spongilla alba* in Lake Shinji, Shimane, Japan, collected on 5 November 1989 by Y. Masuda.

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